FaceKeeper

Privacy-Aware Distributed Computation of Family Photo Collections

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Research Objectives

Designing a novel system for family photo collection analysis by:

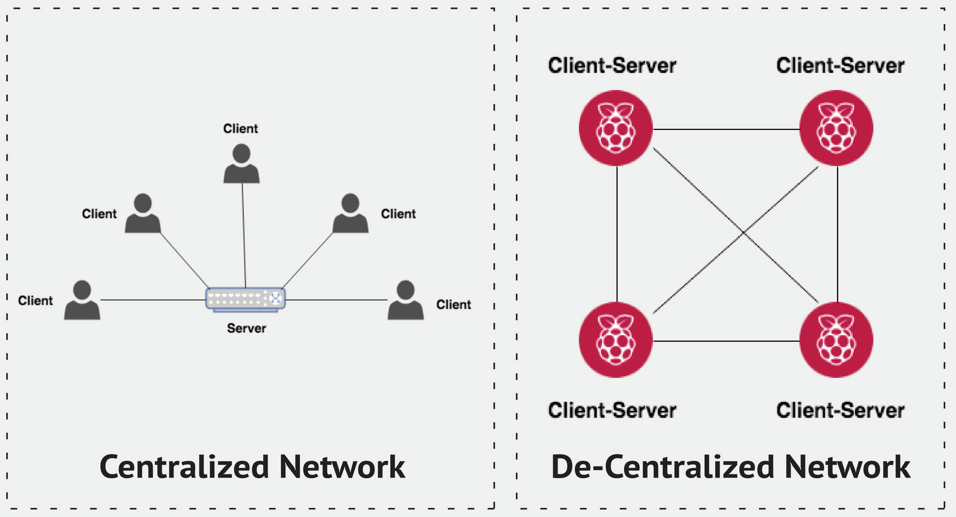
- **leveraging local home networking**
- **reducing dependence on cloud services**
- **prioritizing privacy**
- **maximizing sustainability through device reuse (Internet of Things)**

Background

- Family photos are personal, private information. There is a need for alternative storage models for secure, private (offline) media archiving & curation.

66% Individuals[1] don't store confidential information on cloud

50 Billion Family Photos uploaded to Google Photos

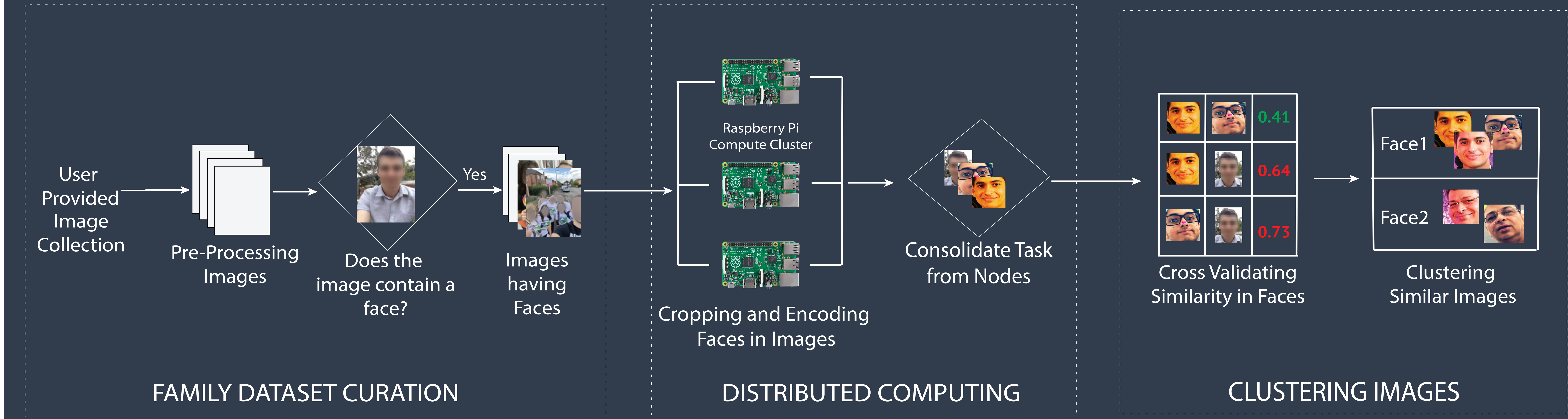


Research Challenge:

- Processing-intensive computations (such as photo analysis) are usually performed on a single powerful machine, or a network of processors hosted as a cloud service.
- A single, dedicated powerful machine is expensive and not sustainable.
- Lots of "smart" home electronics have small embedded processors that could be networked to do processing-intensive tasks.

System Hardware/Software Architecture

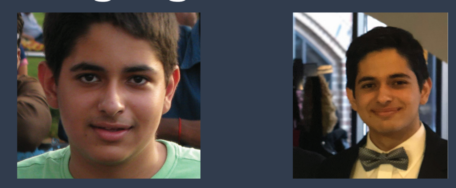
Networking low-performance OTS processors into an high-performance in-home cloud.



(o) The project was trained on a self-curated Family Photo Collection dataset.

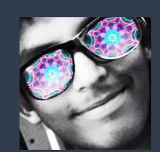
(o) Handling Visually Challenging Cases:

Age Difference

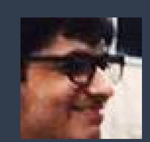


Jun 2011 April 2018

Snapchat/Instagram Filters



Different Face Angles/Occlusion



Tools Used:

(o) Celery - Distributed Task Queue
(o) RabbitMQ - Message Broker
(o) Python - Programming Language
(o) MongoDB[2] Database Systems
(o) OpenFace - Facial Recognition Library

Hardware Used:

(o) Raspberry Pi - Distributed Computing
(o) Cisco SG110D - Network Switch

(o) The **first version** of the project had a compute time of **5 Days for 400MB** collection of Images.

(o) Continuous evolution and improvements in prexisting library code brought the compute time down to **62 seconds for 400MB** collection of Images.

(o) The research project was built around firewall limitations in accordance to the University of Minnesota Network security.

Results

Accuracy: 89.7%

Speed: 6.4 MB/Second

Active Cores: 16
Core Clock Speed: 1 GHz

1 https://googleblog.blogspot.in/2016/05/google-photos-oneyear-200-million.html

2 B. Amos, B. Ludwiczuk, M. Satyanarayanan, "Openface: A general-purpose face recognition library with mobile applications," CMU-CS-16-118, CMU School of Computer Science, Tech. Rep., 2016.

Outcomes & Deliverables

A robust face clustering algorithm written in Python, with documentation available for open source use on GitHub .

Reverse Image Search on Photo Collection feature was built complementing the research.

The delivered software supports device re-use by supporting single-board computers such as Raspberry Pi.

Future Work

Integration to build a number of photo curation and personal reflection applications.

Integrating Relationship Network for analyzing and predicting connections between different individuals.

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Demo

https://z.umn.edu/findme